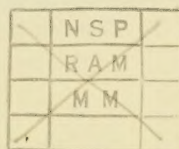


AGRICULTURAL EXPERIMENT STATION
of the RHODE ISLAND STATE COLLEGE
Kingston, Rhode Island, U. S. A.

**Pathogenicity and Control of Corticium
Fuciforme**

LESTER E. ERWIN



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ABSTRACT

Corticium fuciforme first caused serious injury to the turf of lawns, golf courses, and polo fields in Rhode Island in the spring and early summer of 1934.

The signs and symptoms of the disease are confined to the aerial portion of turf grasses. The pathogen forms an effuse gelatinous layer, which spreads over the leaves and stems. Sclerotia and additional gelatinous layers are formed as the pathogen extends out from each infection center, binding the leaves and stems of the grass together. Symptoms of necrosis first appear at the point of infection which may occur at any place on the leaf or leaf sheath. In the early stages the infected tissues are water soaked; later they become dry and lose their color. The turf is killed in areas two to six inches in diameter.

In the greenhouse the characteristic symptoms of the pathogen develop in two days after planting of mycelium or sclerotia. Temperature relationships are as follows: the minimum about 1° C., the optimum 20° C., and the maximum between 25° C. and 30° C. A temperature of 30° C. inhibits the pathogen.

Experiments conducted in the greenhouse at 18° to 22° C. showed that all commonly used turf grasses are susceptible. In various field studies conducted on putting greens, fairways and lawns, a satisfactory control of the pathogen was secured by applications of a number of fungicides.

It was also demonstrated that the use of nitrogenous fertilizers such as sulphate of ammonia or nitrate of soda, on poor lawns or poor fairways would check the pathogen. The best results were secured by applying these fertilizers in April or May.

Pathogenicity and Control of *Corticium Fuciforme* (Berk.) Wakef.¹

LESTER E. ERWIN

INTRODUCTION

Pink patch caused by *Corticium fuciforme* (Berk.) Wakef. was first found in Australia in 1854 and in England in 1880 but was not observed in this country until 1932. At that time it was found in Washington County, Rhode Island, on golf courses, lawns, and polo fields. A hasty survey showed that the pathogen was widely distributed and destructive throughout the State. Greenkeepers were helpless to combat the pathogen which caused the greens to be imperfect and unsightly. The seriousness of this new disease coupled with the prevalence of golf courses in the State made it imperative for the experiment station to study the disease and if possible devise practical control measures. Preliminary investigations showed that before any such recommendations could be made, a thorough study of the signs, symptoms, susceptibility of the various turf grasses, influence of acidity, effect of environmental conditions and the roll of fungicides and fertilizers was necessary.

SIGNS AND SYMPTOMS

The signs and symptoms of *Corticium fuciforme* are confined to the aerial portion of turf grasses. The pathogen consists of an effuse glutinous layer, attached to cuticle which develops as a pink gelatinous layer over the leaves and stems in isolated patches. From the edges of this layer or its outgrowths fine hyphae emerge to extend in widening circles, as a spiral, faintly pinkish web between the leaves of the grass, to which they adhere and produce further gelatinous layers and outgrowths. Hence by vegetative growth the pathogen extends around each infection center, binding the leaves and stems of the grass together. Symptoms of necrosis first appear at the point of infection. In the greenhouse these necrotic symptoms develop in two days after planting of mycelium or sclerotia. This may take place at any point on the leaf or leaf sheath and only through stomatal openings. In the early stages, the affected tissues are water soaked, later they become dry and lose their color. If infection takes place at the tip of the leaf, the pathogen may grow down into the leaf sheath, killing all of the plant above the ground. In cases when infection takes place at some other point below the tip of the leaf, the pathogen may grow up or down killing the tissues as it advances. In some cases, due to unfavorable growth conditions, the pathogen injures

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only the tips of the leaves, but in many cases the grass is killed in areas two to six inches in diameter. These patches are circular in shape and may occur only in a few scattered places (Fig. 1) or may exist as numerous dead areas over the entire surface of a green (Fig. 2). These imperfect

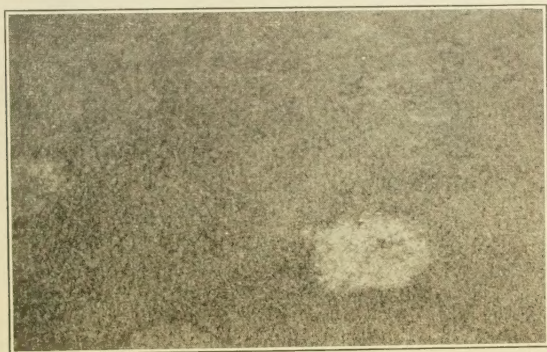


FIG. 1.—*Washington creeping bent turf showing infection of Corticium fuciforme*

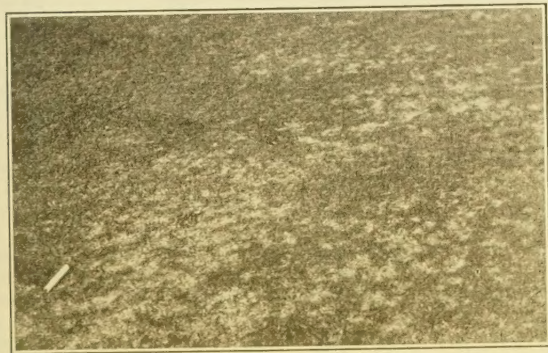


FIG. 2.—*Rhode Island Colonial bent turf showing infection of Corticium fuciforme*

and unsightly areas of dead turf cause a slight depression on the surface of the green. When a golf ball strikes these areas, it may jump, causing the putt to be inaccurate. The tissues of the leaves in these diseased areas become a dirty white in color and, when the pathogen is active, numerous sclerotia are present on the leaves and leaf sheaths. These sclerotia are a bright coral pink in color, variously branched (resembling the seaweed *Fucus*) and vary from one to five centimeters in length (Fig. 3). The sclerotia are broken off and carried to a new location where

they start a new growth. These sclerotia germinate at either end, thus forming a new center of infection.



FIG. 3.—Sclerotia of *Corticium fuciforme*. X60.

There are several other pathogens which kill the turf on putting greens, lawns, and fairways. These are brown patch (*Rhizoctonia solani* Kühn), dollar spot (*Sclerotinia homoeocarpa* Ben.), spot blight (*Pythium butleri*, But.), and snow mold (*Fusarium nivale* Cesati). Brown patch occurs in irregularly-shaped browned areas, usually more or less circular, varying from one inch to three feet in diameter. A black ring may be seen around these areas when the pathogen is active. The pathogen penetrates the host tissue through the stomata and rapidly spreads through the leaf tissue. This causes the host tissue to become black and water soaked. These tissues dry and turn light brown in color. The pathogen flourishes at a temperature of 20° to 26° C. in the presence of high humidity.

Dollar spot occurs in spots on turf ordinarily not larger than a silver dollar. They are usually regular in size and shape. The pathogen penetrates the host tissue through the stomata and rapidly spreads through the leaf tissue. This causes the host tissues to become black and water soaked. These tissues dry and become a straw color. The

pathogen flourishes at a temperature of 15° to 25° C. in the presence of high humidity.

Spot blight appears as a circular spot of blackened grass blades intertwined with a cottony growth of mycelium. The blackened host tissue becomes water soaked as the pathogen penetrates. These tissues dry and become a reddish brown in color. The pathogen flourishes at a temperature of 32° to 35° C in the presence of high humidity.

Snow mold appears first as a thick cottony growth of mycelium covering patches of the turf. These areas vary from one inch to two feet in diameter. The pathogen penetrates the host tissues, which become water soaked and lose their color. These tissues dry and become a dirty white. The pathogen flourishes at a temperature of 1° to 15° C.

DISTRIBUTION, PREVALENCE, AND ECONOMIC IMPORTANCE

Corticium fuciforme, or pink patch, was first observed in Australia by Berkeley (2) in 1854, where it caused dead and bleached areas in fields of ryegrass. Wallis (15), 1873, reported extensive dead and bleached areas in pastures planted to native English grasses. In 1880 Cooke (4) found *C. fuciforme* in England, where it also caused dead areas in fields of native grasses. Pim (10), 1883, found the pathogen on ensilage. Smith (13), 1884, reported dead and bleached areas in fields of *Festuca ovina* L. McAlpine (6), 1899, states that the pathogen destroyed large areas of native and imported grasses. Later he (9), 1906, reported that *C. fuciforme* produced dead and bleached areas in fields planted with the following grasses: *Festuca bromoidea* L., *Agropyron scabrum* Beauv., *Bromus mollis* L., *Bromus sterilis* L., and *Agrostis alba* var. *stolonifera*. At the same time he gave an accurate, detailed description of the fungus, but it was not until 1916 that Wakefield (14) showed that the pathogen belonged to the genus *Corticium* and named it *C. fuciforme* (Berk.) Wakef.

Pink patch was unknown in America until 1932 when the author first found it in Rhode Island on five golf courses, where it caused varying amounts of injury to the turf on the greens. The pathogen spread rapidly until it is of common occurrence on most golf courses in the State, where it attacks the turf on the greens rendering it imperfect and unsightly by the presence of dead and dirty white areas. Pink patch is not confined to the greens alone, but has spread to the fairways where it causes the same type of injury. Investigations showed that pink patch was present in the neighboring states of Massachusetts, Connecticut, and New Hampshire. Robert Mitchell of the Kernwood Country Club, Salem, Massachusetts, reported he had observed the disease on his greens as early as 1929.

Golf is a recreation which in a sense may be classed as an industry in Rhode Island. The estimated yearly income from tourists and summer residents amounts to \$150,000. In Rhode Island there are 42 golf courses that represent an investment of over \$25,000,000. Although this pathogen is of primary importance to golf clubs, it has caused much injury to lawns, by the presence of these dead and unsightly areas. A large number of estates are owned by summer residents who maintain the best type of turf possible. A recent survey of Washington County showed that real estate valued at \$17,000,000 was used for recreational purposes.

GROWTH RESPONSE OF *CORTICIUM FUCIFORME*

The isolates of pink patch used in these studies were taken mostly in Rhode Island; others were received from Massachusetts and Oregon. Samples from Massachusetts were sent in by Robert Mitchell from the Kernwood Country Club, near Salem. The turf was Kernwood velvet bent. The sample from Oregon on Oregon Colonial bent was sent to the author by R. Sprague of the United States Department of Agriculture. The various samples of the infected turf were brought to the laboratory and pure cultures of the pathogen were isolated from the sclerotia. These sclerotia were disinfected by placing them in a 1-1000 solution of bichloride of mercury for two minutes and rinsing three times in sterile distilled water.

The gross morphology was studied on various media in petri dishes: Beer wort (pH 4.9), potato dextrose (pH 5.6), prune (pH 5.7), lima bean (pH 5.7), bean pod (pH 5.8), Sabouraud's (pH 5.6) and Williams' agar (pH 5.6). All agar used was obtained from the Difco laboratories with the exception of Williams' which contained four per cent peptone, one per cent dextrose, and one and one-half per cent agar. Sclerotia were planted in the center of each petri dish and incubated at 20° C. The results after 12 days showed that the amount, color and type of mycelial growth differed with the medium used. Prune agar showed a spiral type of growth. The mycelium was light pink in color, texture coarse and it grew in strands. Lima bean agar showed a clear zone just outside the edge of the growing mycelium. The growth was abundant, fluffy and fine in texture on the beer wort agar and potato dextrose agar. The mycelium was light pink on beer wort agar while on the potato dextrose agar it was a pale pink or almost white in color. Sabouraud's and Williams' each showed a dense feathery growth but differed as to color. On Sabouraud's medium the color was a light pink while on Williams' the color was a very dark or intense pink.

Influence of Acidity

Since the amount of mycelial growth on the above types of media differed, studies were conducted using media adjusted to different pH's, from a low pH of 3.6 to a high pH of 8.0. Difco beer wort agar, potato dextrose agar, lima bean agar, prune agar, corn meal agar, and bean pod agar were used in this test. Sclerotia were planted in the center of the petri dishes after the agar had hardened and all plates were incubated at 20° C. for 12 days. On the lima bean agar slight growth was recorded at a pH of 3.6. The growth increased until the largest amount was recorded at a pH of 4.0. At still higher pH's the amount of growth decreased. No growth occurred at a pH of 8.0. On potato dextrose agar the pathogen grew on all plates. The largest amount of growth occurred at a pH of 5.2 and at higher pH's the amount decreased. Beet wort also supported growth on all plates but the largest amount occurred at a pH of 4.8 and decreased at the higher pH's. The largest amount of growth occurred on the beer wort agar plates. The pathogen did not grow on corn meal agar plates with a pH of 3.6, but growth was recorded on all the others with the maximum growth occurring at a pH of 4.4. In all cases the growth on corn meal agar was scant. On prune agar the growth occurred on all the plates, the largest amount was recorded on the plates with a pH

of 5.2 and growth decreased at the higher pH's. Bean pod agar showed no growth on plates whose pH was below 4.8. The largest amount of growth occurred on the plates with a pH of 6.0. In all cases the growth on the bean pod agar was very poor and scant (Table 1).

TABLE 1.—*Influence of Acidity on rate of growth of Corticium fuciforme on six media at 20° C. expressed as diameter of colonies in millimeters.*

Nutritive medium.....	pH range of media									
	3.6	4.0	4.2	4.4	4.8	5.2	6.0	6.2	7.0	8.0
Lima bean agar.....	1	2	4	15	30	26	9	6	3	0
Potato dextrose agar.....	1	3	6	16	35	72	40	12	9	8
Beer wort agar.....	3	15	30	46	90	61	51	47	11	8
Corn-meal agar.....	0	15	19	23	20	18	16	9	6	4
Prune agar.....	3	12	15	18	21	35	19	12	3	2
Bean pod agar.....	0	0	0	0	3	5	13	9	6	2

Beer wort agar gave the best growth on the series of plates, followed by the potato dextrose. Bean pod agar showed the poorest growth in the series. This test showed that the pathogen will grow at pH 3.6 on lima bean, potato dextrose, beer wort, and prune agar and that growth occurred at a pH of 8.0 on potato dextrose, beer wort, corn meal and prune agar. In this test 3.6 was the minimum, 4.4 to 6.2 the optimum, and near 8.0 the maximum for the beer wort, potato dextrose and prune agar.

Temperature Relationships

Temperature studies were conducted using five isolates of pink patch. Three of these were isolated from Rhode Island turf, one from Massachusetts turf and the other from turf received from Oregon. Bits of mycelium from the various isolates were planted on plates of beer wort agar and potato dextrose agar. Duplicate plates of each type of agar were incubated for 12 days at the following temperatures: 1° C., 5° C., 9° C., 12° C., 15° C., 18° C., 20° C., 25° C., and 30° C.

At one degree Centigrade the first growth was recorded on the fifth day with exception of the Kernwood isolate which did not show growth until the seventh day. Growth at this temperature was very slight and was recorded as a trace. At 5° C. the first growth was recorded also on the fifth day. Measurable growth was obtained from the fifth day on. Slightly more growth occurred on the plates containing the beer wort agar. At 9° C. growth was recorded on the third day and increased in amount from day to day. Beer wort agar again showed more growth than the potato dextrose agar. At 12° C., 15° C., 18° C., 20° C., and 25° C. growth was recorded on the second day. Growth increased from day to day at each of these temperatures. Beer wort agar showed larger amounts of growth at all these temperatures than did the potato dextrose agar. No growth occurred at 30° C.

The average daily growth on beer wort and potato dextrose agar increased at the different temperatures up to 20° C. At 20° C. the largest amount of growth was recorded. The amount of growth then decreased, smaller amounts being recorded at 25° C. At 30° C. no daily growth was recorded (Tables 2 and 3).

TABLE 2.—Average daily growth of *Corticium fuciforme* at different temperatures (°C.) on potato dextrose agar (pH 5.6).

Isolate	Tempera- ture °C	Appearance of growth No. of days	Average daily diameter of colony in mm.				
			5	6	8	12	Ave. daily growth
Point Judith . .	1	5	T*	T	T	T	T
Kernwood . . .	1	7	None	None	T	T	T
Louisquisset . .	1	5	T	T	T	T	T
Sachuest	1	5	T	T	T	T	T
Oregon	1	5	T	T	T	T	T
Point Judith . .	5	5	0.3	0.5	1.0	2.25	0.32
Kernwood	5	3	0.3	0.6	1.0	4.20	0.60
Louisquisset . .	5	5	1.0	2.0	6.0	7.20	1.02
Sachuest	5	5	1.0	2.0	5.0	8.00	1.10
Oregon	5	5	0.3	1.2	1.9	2.10	0.30
Point Judith . .	9	3	3.0	6.0	7.0	8.00	0.89
Kernwood	9	3	1.0	3.0	5.0	9.90	1.10
Louisquisset . .	9	3	1.0	2.0	7.0	10.30	1.15
Sachuest	9	3	2.0	5.0	8.0	14.00	1.55
Oregon	9	3	0.6	2.0	3.0	6.00	0.64
Point Judith . .	12	2	5.0	8.0	10.5	16.80	1.68
Kernwood	12	2	2.0	3.5	8.0	12.80	1.28
Louisquisset . .	12	2	2.0	4.0	9.2	15.20	1.52
Sachuest	12	2	3.0	8.0	11.0	28.90	2.89
Oregon	12	2	2.0	2.8	4.1	8.00	0.80
Point Judith . .	15	2	6.8	10.1	15.5	21.50	2.15
Kernwood	15	2	2.8	8.5	19.0	27.50	2.75
Louisquisset . .	15	2	8.1	14.0	20.0	32.50	3.25
Sachuest	15	2	3.0	8.0	20.0	30.1	3.01
Oregon	15	2	4.8	8.1	12.0	19.5	1.95
Point Judith . .	18	2	7.0	14.3	18.5	29.2	2.92
Kernwood	18	2	3.7	9.1	21.2	32.0	3.20
Louisquisset . .	18	2	13.2	20.0	27.0	44.0	4.40
Sachuest	18	2	4.4	12.2	23.1	38.0	3.80
Oregon	18	2	5.4	9.7	14.4	22.0	2.20
Point Judith . .	20	2	8.4	15.3	22.0	32.5	3.25
Kernwood	20	2	5.2	12.1	25.2	37.2	3.72
Louisquisset . .	20	2	18.0	26.2	36.1	56.0	5.60
Sachuest	20	2	12.0	18.0	29.2	45.0	4.50
Oregon	20	2	9.0	14.0	20.0	29.2	2.92
Point Judith . .	25	2	2.8	11.2	16.6	21.0	2.10
Kernwood	25	2	4.0	10.2	18.2	19.0	1.90
Louisquisset . .	25	2	9.0	15.0	17.5	29.2	2.92
Sachuest	25	2	7.0	12.0	15.8	24.5	2.45
Oregon	25	2	5.5	8.0	13.0	20.0	2.00
Point Judith . .	30	None	0.0	0.0	0.0	0.0	0.00
Kernwood	30	None	0.0	0.0	0.0	0.0	0.00
Louisquisset . .	30	None	0.0	0.0	0.0	0.0	0.00
Sachuest	30	None	0.0	0.0	0.0	0.0	0.00
Oregon	30	None	0.0	0.0	0.0	0.0	0.00

* = Trace

TABLE 3.—Average daily growth of *Corticium fuciforme* at different temperatures (°C.) on beer wort agar (pH 4.9).

Isolate	Temperature °C.	Appearance of growth No. of days	Average daily diameter of colony in mm.					Ave. daily growth
			5	6	8	12		
Point Judith..	1	5	T*	T	T	T	T	
Kernwood....	1	7	None	None	T	T	T	
Louisquisset..	1	5	T	T	T	T	T	
Sachuest.....	1	5	T	T	T	T	T	
Oregon.....	1	5	T	T	T	T	T	
Point Judith..	5	5	1.5	2.7	5.0	8.0	1.40	
Kernwood....	5	5	1.0	1.8	4.2	6.4	0.91	
Louisquisset..	5	5	2.0	3.0	6.0	9.1	1.30	
Sachuest.....	5	5	2.0	3.0	7.0	12.0	1.70	
Oregon.....	5	5	1.0	2.0	3.0	4.0	0.57	
Point Judith..	9	3	4.0	6.0	11.0	16.5	1.83	
Kernwood....	9	3	1.0	3.0	7.5	11.0	1.22	
Louisquisset..	9	3	2.0	3.0	6.0	11.0	1.22	
Sachuest.....	9	3	3.0	7.0	13.5	17.0	1.89	
Oregon.....	9	3	0.8	3.0	5.0	8.5	0.94	
Point Judith..	12	2	5.6	9.0	14.0	23.2	2.34	
Kernwood....	12	2	2.0	3.8	12.5	23.0	2.30	
Louisquisset..	12	2	3.0	9.5	13.0	32.5	3.25	
Sachuest.....	12	2	3.0	10.5	16.0	37.0	3.70	
Oregon.....	12	2	2.0	3.7	5.6	10.0	1.00	
Point Judith..	12	2	7.0	12.0	19.0	39.5	3.95	
Kernwood....	15	2	3.5	10.5	27.8	39.0	5.90	
Louisquisset..	15	2	10.9	17.5	26.0	45.2	4.52	
Sachuest.....	15	2	3.5	9.3	25.0	50.0	5.00	
Oregon.....	15	2	6.5	10.6	14.0	25.0	2.50	
Point Judith..	18	2	7.0	16.0	21.0	51.0	5.10	
Kernwood....	18	2	4.5	15.2	36.2	65.0	6.50	
Louisquisset..	18	2	24.7	31.4	47.0	69.7	6.97	
Sachuest.....	18	2	5.5	14.0	29.5	58.0	5.80	
Oregon.....	18	2	7.5	12.6	20.0	31.0	3.10	
Point Judith..	20	2	9.5	19.5	31.0	68.0	6.80	
Kernwood....	20	2	15.0	32.8	48.5	70.1	7.01	
Louisquisset..	20	2	18.0	39.0	58.0	91.2	9.12	
Sachuest.....	20	2	14.0	29.0	47.0	72.0	7.20	
Oregon.....	20	2	15.0	24.5	35.0	60.0	6.00	
Point Judith..	25	2	6.6	15.1	22.1	30.0	3.00	
Kernwood....	25	2	4.0	13.7	21.2	26.5	2.65	
Louisquisset..	25	2	11.7	17.6	24.5	41.2	4.12	
Sachuest.....	25	2	9.0	13.5	20.5	33.5	3.35	
Oregon.....	25	2	11.5	22.0	28.0	32.3	3.25	
Point Judith..	30	None	0.0	0.0	0.0	0.0	0.00	
Kernwood....	30	None	0.0	0.0	0.0	0.0	0.00	
Louisquisset..	30	None	0.0	0.0	0.0	0.0	0.00	
Sachuest.....	30	None	0.0	0.0	0.0	0.0	0.00	
Oregon.....	30	None	0.0	0.0	0.0	0.0	0.00	

* = Trace

The daily growth and average daily growth of the five isolates were slightly different at each of the temperatures. The isolate from Louisiquisset showed the largest amount of growth at 20° C., but Sachuest, Kernwood, and Point Judith showed good growth at this temperature. The isolate from Oregon showed the poorest growth at all temperatures. These studies show (Fig. 4 and 5) that the minimum temperature for the growth of pink patch lies near 1° C., the optimum temperature 18° C. to 22° C., and the maximum temperature at which growth occurs near 30° C. (Fig. 4 and 5). All isolates agree in making maximum growth at average summer temperature. In the field this maximum growth period is shortened by restriction of moisture, and the greatest growth would then occur in the spring and fall.

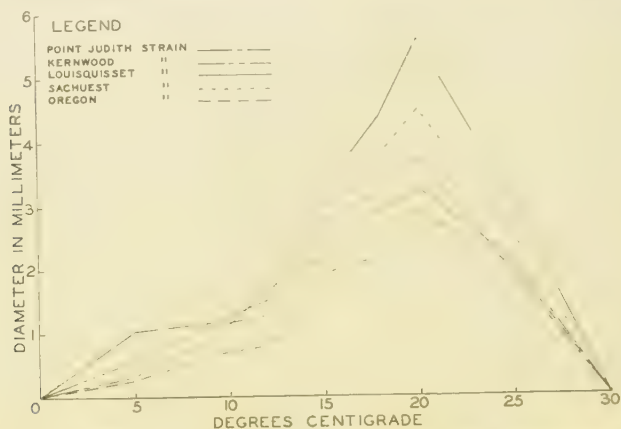


FIG. 4.—Average daily growth of *Corticium fuciforme* at different temperatures on potato dextrose agar (pH 5.6).

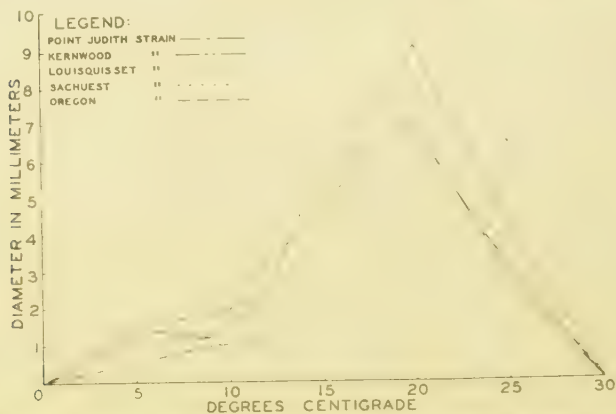


FIG. 5.—Average daily growth of *Corticium fuciforme* at different temperatures on beer wort agar (pH 4.9).

Studies were conducted to show the influence of abnormal temperatures. Cultures of pink patch were planted in duplicate on beer wort agar and potato dextrose agar. These were incubated for six days at 20° C., the optimum temperature for growth of the fungus. At the end of six days these plates were removed to a 35° C. incubator and kept there for 10 days. They were then placed at 20° C. The pathogen resumed growth, showing that it was not killed by incubating at 35° C. Further experiments at this same temperature conducted on three different dates using duplicate plates of beer wort agar and potato dextrose agar gave the same results. In other studies the pathogen was grown on beer wort agar and potato dextrose agar for six days at 20° C. and then incubated at 7° C. for 30 days. Then these plates were again incubated at 20° C. Growth was resumed by the end of the second day.

These studies showed the ability of the pathogen to withstand low temperatures for a long period of time. Further studies were conducted and the same results obtained. The sclerotia of pink patch were stored at 25° C. for 18 months. At the end of this time they were plated on beer wort agar and potato dextrose agar and incubated at 20° C. Growth was visible on the plates by the end of the second day. Thus, the sclerotia are resistant to drying. Further studies using three different lots of sclerotia and holding them at 25° C. for 18 months again showed that after plating on beer wort agar or potato dextrose agar, growth was obtained by the end of the second day.

Susceptibility of Commonly Used Turf Grasses

Experiments were conducted in the greenhouse at 18° to 22° C. to study the relative susceptibility of some of the commonly used turf grasses with the hope that some might show some resistance to pink patch. Vegetative turf and seedling turf were used in these studies. Four-inch plugs of vegetative turf of Oregon Colonial bent, Rhode Island Colonial bent, Washington creeping bent, seaside creeping bent, Kernwood velvet bent, Piper velvet bent, Kentucky bluegrass, and redbot were taken from the demonstration plats at the Rhode Island Agricultural Experiment Station and placed in five-inch pots. Enough good soil and compost were added so that the grasses were even with the top of the pot. The grasses were watered daily and kept clipped at a height of one-fourth inch. After 14 days when the turf in the pots had become adjusted to the new surroundings, the infection studies were started. Seed of Piper velvet bent, Kernwood velvet bent, Rhode Island Colonial bent, redbot, and Kentucky bluegrass was also planted in five-inch pots. These were watered daily and the grass was maintained at the one-fourth inch height. After 28 days the turf was mature enough to start infection studies.

In these studies one series of pots were planted with sclerotia and in another series bits of mycelium from pure cultures of pink patch were used. These pots and the check pots were covered with one liter beakers. In this way the moisture was preserved and a high degree of humidity was obtained.

On the second day after planting sclerotia and bits of mycelium in these pots, all the pots in the series showed signs of infection. Water-soaked areas developed at the point of infection where an effused glutinous

layer of mycelium attached itself to the cuticle of the leaf. From the edges of this layer fine hyphae emerged and extended as a pinkish web attached to the leaves. Thus, the vegetative growth of the pathogen extended around the infection center binding the leaves and stems together. The pathogen spread in an ever-widening circle until by the end of the 20th day the turf in all artificially infected pots was severely injured. The turf in the check pots remained healthy throughout. The velvet bents were injured more than the other grasses. The pathogen killed all the aerial portions while on the other grasses which do not produce such a dense turf as the velvet bents, some scattered leaves showed no infection. (Fig. 6, 7, 8, 9, 10.)



FIG. 6.—Influence of temperature on the rate of growth of *Corticium fuciforme* (potato dextrose agar).

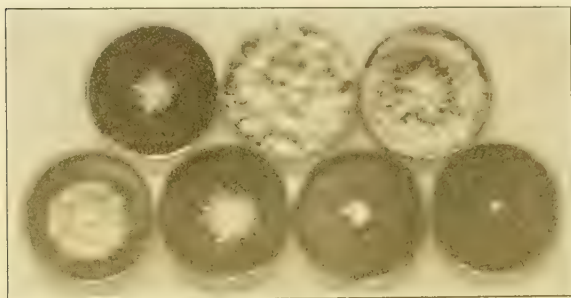


FIG. 7.—Influence of temperature on the rate of growth of *Corticium fuciforme* (beer wort agar).

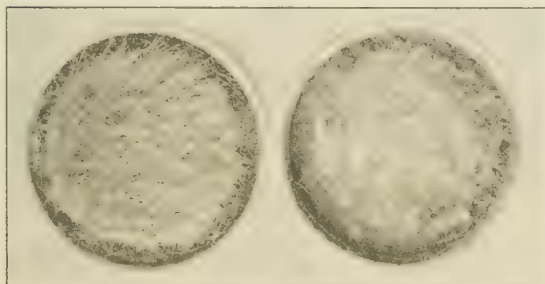


FIG. 8.—Kernwood velvet bent turf from seed planted with sclerotia of *Corticium fuciforme*. Left, control pot. Right, infected pot, 25 days after planting. Temperature 18° C. to 22° C.

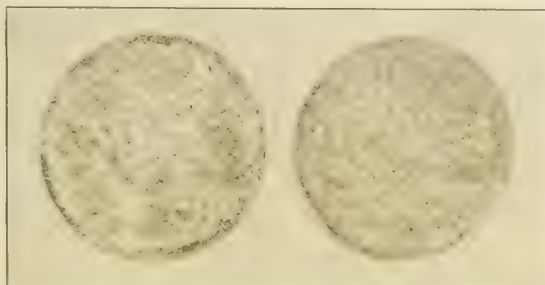


FIG. 9.—Rhode Island Colonial bent turf from seed planted with bits of mycelium of *Corticium fuciforme*. Left, control pot. Right, infected pot, 25 days after planting. Temperature 18° C. to 22° C.



FIG. 10.—Kernwood velvet bent turf planted with sclerotia of *Corticium fuciforme*. Left control pot. Right, infected pot, 25 days after planting. Temperature 18° C. to 22° C.

These studies showed that both the vegetative turf and the seedling turf were equally susceptible to pink patch. All species of grasses used in these studies were susceptible. Four new hosts were found: Redtop, Kentucky bluegrass, velvet bent, and Colonial bent.

Five years of study and observations in the field showed that the above mentioned new hosts were found infected on 15 occasions. In addition during this period the following new hosts were found infected on 10 different occasions under field conditions: Red fescue, hair fescue, and annual bluegrass.

Toxicity of Certain Fungicides

In considering the toxic effect of chemical materials toward a fungus, it is very necessary to find a concentration which will kill the fungus without injuring the turf.

Experiments (Table 4) were conducted to study the toxicity of certain fungicides, namely: Semesan, Calo-clor, Fungol, Nu-green, bichloride of mercury, and calomel. The fungicides were made up in the following dilutions: 1-1000, 1-2000, 1-4000, 1-5000, and 1-10,000. One cubic centimeter of the dilution was added to 10 cubic centimeters of beer wort agar and potato dextrose agar which had been cooled to 45° C. The fungicide was thoroughly mixed with agar in the test tube and plates poured. Bits of mycelium were planted in the center of the poured plates. Each dilution as well as the control plates was run in duplicate and incubated at 20° C. The amount of growth on each petri dish was measured at the end of 12 days as the diameter of colonies. Even with the highest dilution some inhibition was evident, although some growth (in many instances very slight) occurred on media with 1-1000 parts of the fungicide; namely, the Semesan, Calo-clor, and bichloride of mercury plates.

Fungol inhibited the growth of pink patch in dilutions of 1-1000 and 1-2000 but at the higher dilutions it was not so effective. Nu-green inhibited the growth of the pathogen well at a dilution of 1-1000 but higher dilutions were not so effective. Calomel was not as effective as the other chemicals used.

TABLE 4.—*Toxicity of chemicals on Corticium fuciforme grown on beer wort agar and potato dextrose agar. Vigor of growth indicated by diameter of colonies expressed in millimeters.*

Fungicide	Medium	Dilution of fungicide				
		1-000	1-2000	1-4000	1-5000	1-10,000
Fungol	Beer wort	3.0	8.0	26.0	45.0	68.0
	Potato dextrose	2.5	6.0	20.0	40.0	60.0
Semesan	Beer wort	0.5	5.0	9.0	12.0	30.0
	Potato dextrose	1.0	4.5	6.0	8.0	25.0
Calo-clor	Beer wort	2.5	5.5	12.0	12.0	29.0
	Potato dextrose	2.0	5.0	10.0	15.0	22.0
Nu-green	Beer wort	4.0	10.0	34.0	55.0	72.0
	Potato dextrose	4.0	8.0	30.0	50.0	69.0
Corrosive sublimate	Beer wort	2.0	6.0	16.0	21.0	32.0
	Potato dextrose	1.5	4.5	11.0	18.0	27.0
Calomel	Beer wort	12.0	30.0	45.0	65.0	80.0
	Potato dextrose	9.0	25.0	39.0	60.0	75.0
Check	Beer wort					90.0
	Potato dextrose					82.0

= Semesan—Hydroxymercurichlorophenol, 30 per cent; inert, 70 per cent.

Calo-clor—Bichloride of mercury, 33½ per cent; calomel, 66½ per cent.

Fungol—Secret formula.

Nu-green—Hydroxymercurichlorophenol, 19.5 per cent; inert, 80.5 per cent.

Mercury Vapor

Zimmerman and Crocker (16) have shown that mercury and mercurial compounds give off vapor which is toxic to plants under certain conditions. Since mercurial compounds are used in the control of turf diseases this study was conducted to determine if possible if these vapors were toxic to the fungus on the leaves. It is known that if these materials are used according to directions no apparent injury is present on the grass. These experiments were conducted at the optimum temperature for the growth of the pathogen, 18° C. to 22° C. The following materials were used: metallic mercury, bichloride of mercury, calomel, Semesan, and Calo-clor. Three-inch plugs of the infected turf which still showed some green leaves were obtained and placed in five-inch pots. With the exception of the metallic mercury the chemicals to be tested were each mixed with an equal amount by weight of blood meal. Dunham's fermentation tubes were half filled with these mixtures. Care was taken to see that the mixture was not packed in the tube. Dunham's fermentation tubes were half filled with metallic mercury and used. Six tubes of metallic mercury, calomel, bichloride of mercury, Calo-clor, and Semesan were placed in separate plugs of infected turf, the top of each tube being level with the soil of the plug. A 600 cubic centimeter beaker was placed over each pot. Two check pots were covered with 600 cubic centimeter beakers. These pots were incubated at 18° C. to 22° C. for 72 hours. Six pieces of the sclerotia were picked from each of the pots and plated on beer wort agar

and potato dextrose agar and incubated at 20° C. for six days. The sclerotia taken from the treated pots failed to grow, while those from the check pots showed abundant growth at the end of six days. Four repeated trials gave the same results.

These trials showed that vapor of mercury was toxic to the sclerotia of pink patch after 72 hours exposure while the green leaves showed no injury. It is possible or even perhaps probable that part of the controlling action of mercury and its compounds on the pathogen when used in the field is due to the vaporization of the chemical.

CONTROL OF *CORTICIUM FUCIFORME*

A detailed study of pink patch in the field showed that the pathogen was found on colonial bent, creeping bent, and velvet bent (Fig. 11) used as turf on greens, and on hair fescue, red fescue and Kentucky bluegrass used as turf on fairways. Any one or a combination of several of the above mentioned grasses may be used for lawns. Therefore, it was necessary to find control measures suitable for conditions found on greens, fairways, and lawns.

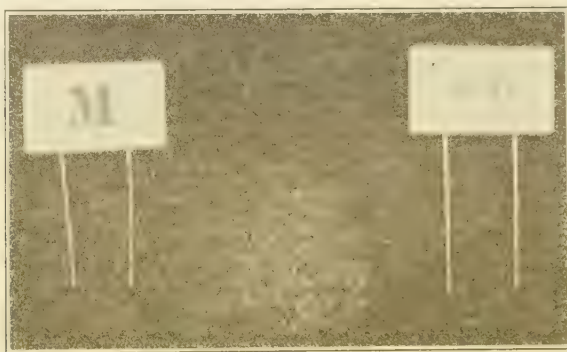


FIG. 11.—Putting green of *Piper* velvet bent showing infection of *Corticium fuciforme*.

The problem was threefold. First, on the greens the turf is grown under artificial conditions. Fertilizers are applied at intervals throughout the growing season which is from April to October. The greens are composted regularly and water is applied at intervals to keep the turf from drying. The turf is cut at one-fourth inch height, thus causing a soft luxuriant growth of grass. Second, the turf on fairways receives little attention other than regular mowing during the growing season because of the expense involved. In most cases neither fertilizer nor water is applied. Third, on lawns several conditions are presented. The turf on some lawns is fertilized and watered throughout the growing season, thus receiving care similar to that of the greens other than the height of mowing. In most cases the turf on lawns is cut at a three-fourth inch height. Other lawns receive fertilizer only in the spring and small amounts of water during the growing season. However, the average lawn receives neither

fertilizer nor water. A number of experiments were conducted to study the pathogen and its control under the above mentioned conditions.

Treatment of Turf on Putting Greens

In July, 1933, preliminary experiments were conducted to study the effect of fungicides. The first experiment was conducted on golf course number one. Four greens of Rhode Island Colonial bent on this course showed 60 per cent infection on July 2. These greens each contained 4000 square feet of turf. All the greens were treated with Semesan at the rate of one pound per 1000 square feet. This was mixed with 20 quarts of screened sand and applied broadcast. The greens were watered immediately after the application. Each green had an extension known as an apron which contained 1000 square feet. The apron of each green was used as a check. The first application of the fungicide was made on July 2 and repeated applications were made at two-week intervals until the first of September.

At the end of the third day, after the first application of the fungicide, although weather conditions were favorable for the pathogen, it had become inactive and it was impossible to find mycelium or sclerotia. The treated greens recovered rapidly. The infection was reduced from 60 per cent to 15 per cent by July 24 and to 5 per cent by August 22, while on the aprons that were used as checks the pathogen remained active and the percentage of infection increased from 60 to 75 per cent by August 22. This experiment showed that Semesan used at the rate of one pound per 1000 square feet of turf will check the growth of pink patch.

In July, 1933, another preliminary experiment was conducted on golf course number two. Two greens of seaside creeping bent were used in this experiment. One contained 5000 square feet and the other 3500 square feet of turf.

Calo-clor at the rate of three ounces per 1000 square feet was used. This was mixed with 20 quarts of screened sand and applied broadcast. The greens were watered immediately after the application of the fungicide. The extension or apron of each green contained 1000 square feet and was used as a check. The first application was made on July 10. Additional applications were made at two-week intervals until September 1.

The greens showed 49 per cent infection on July 10. Although weather conditions were favorable for the pathogen, it had become inactive at the end of the third day after the first application of the fungicide. The treated greens recovered rapidly. The infection was reduced to 12 per cent on July 31 and to four per cent on September 1. On the aprons, or checks, the pathogen remained active and the percentage of infection increased from 49 to 62 by September 1. This experiment showed that Calo-clor used at two-week intervals at the rate of three ounces per 1000 square feet of turf would check the growth of pink patch.

In May, 1934, another preliminary experiment using Calo-clor was conducted on golf course number three. Five greens of velvet bent were used in this experiment. Only one-half of each green was treated. The other one-half was used as a check. The areas of the greens were as follows: 3500, 4000, 4200, 4800, and 5000 square feet. Calo-clor was used at the rate of three ounces per 1000 square feet. This was mixed

with 20 quarts of screened sand and applied broadcast. The first application was made May 1. Additional applications were made at two-week intervals until August 1. The greens were watered after each application of the fungicide.

The greens showed 40 per cent infection at the time of the first application of the fungicide. The pathogen was inactive by the end of the third day after the first application. The treated one-half of the greens recovered rapidly. Infection was reduced to 20 per cent by June 5 and to three per cent by July 3. On the checks the infection increased to 50 per cent on July 3. New infection by the pathogen developed on July 10. The treated parts of the greens showed 10 per cent infection on this date and the amount on the checks had increased to 70 per cent. The treated greens showed four per cent infection on August 1 and the checks showed 75 per cent infection. The infected areas on the check plots recovered very slowly and the infected turf was dead and dirty-white in color on August first. The experiment shows that Calo-clor at the rate of three ounces per 1000 square feet, applied at two-week intervals, controlled the pathogen.

In 1936 experiments were conducted to determine the value of four fungicides. The plots were five feet square, each containing 25 square feet of turf. Each fungicide was applied to two different plots and two plots were used as checks. The turf used in this experiment was Rhode Island Colonial bent (Fig. 12). Bordeaux 1-5-50 plus 4.5 ounces malachite green per 1000 square feet of turf was used as a spray. Malachite green, two ounces, plus Auramine O (2 oz.), plus 0.1 gram of crystal violet was used in 50 gallons of water per 1000 square feet of turf. Semesan was used at the rate of one pound per 1000 square feet of turf. This was mixed with 20 quarts of screened sand and applied broadcast. Calo-clor was used at the rate of three ounces per 1000 square feet. This was mixed with 20 quarts of screened sand and applied broadcast. All plots, including the checks, which did not receive the fungicide as a spray were watered at the time of application.



FIG. 12. — Putting green of Rhode Island Colonial bent showing area infected by *Corticium fuciforme*.

The fungicides were applied on June 1 and every 10 days thereafter until September 1. Infection caused by pink patch occurred on June 8, July 1, and August 10.

The pathogen was found on all the plots on June 5. The check plots showed 25 per cent infection while only six per cent was present on the Bordeaux-malachite green plots. The malachite-Auromine 0 plots showed 5 per cent infection. Three per cent infection was found on the Semesan plots and only two per cent on the Calo-clor plots. The treated plots recovered rapidly and on June 25 the Bordeaux-malachite and the malachite-Auromine 0 plots showed an infection of only one per cent. The Semesan and Calo-clor plots had recovered and the turf showed no injury by pink patch on June 25. A new infection of pink patch occurred on July 1. At this time the check plots showed 35 per cent infection while the Bordeaux-malachite green plots showed four per cent; malachite green-Auromine 0, four per cent; Semesan, four per cent; and Calo-clor, three per cent infection. The turf on the treated plots recovered rapidly and on July 30 injury caused by the pathogen could not be found. The check plots showed 35 per cent infection on this date.

A new infection of pink patch occurred on August 10. The check plots showed 40 per cent infection; the Bordeaux-malachite plots, six per cent infection; the malachite green-Auromine 0, six per cent infection. The Semesan and Calo-clor plots each showed an infection of only one per cent. The turf on the treated plots recovered rapidly and on August 30 only five-tenths of one per cent infection could be found on each of the Bordeaux-malachite green and malachite green-Auromine 0 plots. The turf on the Semesan and Calo-clor plots had recovered by August 30. The check plots showed dead and dirty-white areas that made the turf imperfect and unsightly while a dense green turf prevailed on the treated plots.

This experiment shows that better control is obtained by applying Bordeaux-malachite green, malachite green-Auromine 0, Semesan and Calo-clor before infection occurs. Semesan and Calo-clor gave the best control. As these fungicides were mixed with screened sand, they were easier to apply than the sprays of Bordeaux-malachite green and malachite green-Auromine 0 (Table 5).

TABLE 5. Control treatments for *Corticium fuciforme* on pulling greens of Rhode Island bent in 1936

Fungicide	Amount per 1000 sq. ft.	Estimated percentage of infection by <i>C. fuciforme</i> per plot†											
		June 5*	June 15	June 25	June 1*	July 10	July 20	July 30	Aug. 10*	Aug. 20	Aug. 30		
Bordeaux.....	1 lb. hydrated lime..... 5 lbs. copper sulfate..... 50 gals. H ₂ O	6	2	1	4	2	1	0	6	2	0.5		
Malachite green.....	4.5 oz.....												
Malachite green.....	2 oz.....												
Auromine O.....	2 oz.....	5	2	1	4	2	1	0	6	2	0.5		
Crystal violet.....	0.1 gm. in 50 gal. water.....												
Semesan.....	1 lb. mixed with 20 qts. screened sand.....	3	1	0	4	1	0	0	3	1	0		
Calo-clor.....	3 oz. mixed with 20 qts. screened sand.....	2	0.5	0	3	0	0	0	3	1	0		
Check.....		25	25	25	35	35	35	35	40	40	40		

† = The percentage of infection was estimated by determining the percentage of square feet infected in each plot.

* = New infection caused by *C. fuciforme* June 5, July 1, August 10.

Treatment applied June 1, June 10, June 20, June 30, July 10, July 20, July 30, August 9, August 19, and August 29.

As the pathogen also caused injury to the turf on the fairways by the presence of these dead and unsightly areas, it was necessary to study means of controlling pink patch on the fairways.

Treatment of Turf on Fairways

In 1934 experiments were conducted to study the value of fertilizers and fungicides. The plots were five feet square, each containing 25 square feet of turf maintained at a three-fourth inch height. Three plots were used as checks. On August 10, single plots were treated with the following: nitrate of soda at the rate of 35 pounds; sulfate of ammonia, 33 pounds; hydrated lime, 33 pounds; and sulfate of ammonia, 33 pounds plus limestone 33 pounds per 1000 square feet. Each was mixed with 10 quarts of screened compost to prevent burning, applied broadcast. The turf was watered following these applications. Nu-green, at the rate of one pound, and Calo-clor, at the rate of three ounces per 1000 square feet, were mixed with 20 quarts of screened sand and applied broadcast. Water was then applied to the turf. Semesan, at the rate of one pound in 50 gallons of water, and iron sulfate, at the rate of three pounds in 10 gallons of water per 1000 square feet of turf were also used.

The percentage of infection caused by pink patch on these plots was recorded on August 10 before application of the various fertilizers and fungicides. The plot treated with nitrate of soda had 25; sulfate of ammonia, 22; hydrated lime, 20; sulfate of ammonia plus limestone, 21; Nu-green, 20; Calo-clor, 28; Semesan, 25; and iron sulfate, 20 per cent. The three check plots showed an average of 26 per cent infection.

On September 10 the plots showed the following infection: nitrate of soda, 4, turf on plot green and dense; sulfate of ammonia, 4, turf on plot green and dense; hydrated lime, 16, turf on plot dead and dirty-white in infected areas, other part of turf green; sulfate of ammonia plus limestone, 6, turf dense and green; Nu-green, 10, turf green; Semesan, 2, turf green; and Calo-clor, 1, turf green. The check plots showed 32 per cent infection. The iron sulfate spray burned the turf, therefore no records were taken.

These results show that hydrated lime did not check the growth of the pathogen. Nitrate of soda and sulfate of ammonia reduced the infection to four per cent and the turf was dense and green. Calo-clor reduced the infection to one per cent but the turf was not dense. Applications of sulfate of ammonia or nitrate of soda looked promising for control of this pathogen in conditions found on fairways.

These experiments were continued in 1935. The plots received the same treatments as in 1934 with the exception that iron sulfate was omitted. In its place 33 pounds sulfate of ammonia plus three ounces of Calo-clor per 1000 square feet was used. The Semesan was applied by mixing with 20 quarts of screened sand instead of being sprayed on the plot. Fertilizer was applied April 10 and fungicides were applied May 20, June 5, June 20, July 5, and July 15.

The pathogen was observed on May 21 (Fig. 13) and the percentage of infection was as follows: Nitrate of soda, 8; sulfate of ammonia, 7; sulfate of ammonia plus limestone, 9; hydrated lime, 16; sulfate of

ammonia plus Calo-clor, 4; Nu-green, 12; Semesan, 4; Calo-clor, 4; and the checks, 26. New infections by the pathogen occurred on June 20 and July 15. At this time the percentage of infection increased on each treatment but the turf recovered rapidly. The amount of infection on checks increased from 26 per cent on May 24 to 38 per cent on June 20 and to 50 per cent on July 15.

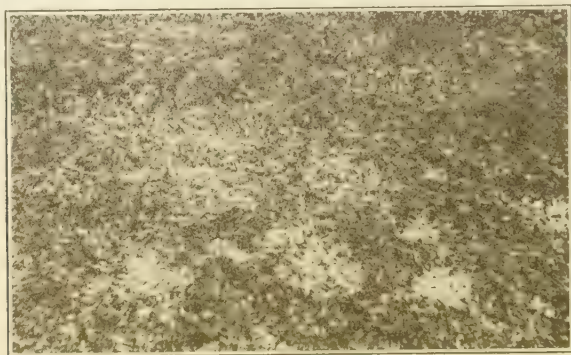


FIG. 13.—Fairway turf of Kentucky bluegrass showing infection of *Corticium fuciforme*.

On August 30 the nitrate of soda plots showed three per cent infection, turf green and dense; sulfate of ammonia, two, turf green and dense; sulfate of ammonia plus limestone, four, turf green and dense; sulfate of ammonia plus Calo-clor, five-tenths, turf dense and green; Nu-green, three, turf green; Semesan, no infection, turf green; Calo-clor, no infection, turf green; and the checks, 50 per cent, turf dead and dirty-white in color. (Table 6).

TABLE 6.—Control treatments for *Corticium fuciforme* on fairways in 1935

Fungicide	Amount per 1000 sq. ft.	Estimated percentage of infection per plot†											
		May 24*	June 1	June 10	June 20*	July 1	July 10	July 15*	July 25	Aug. 3	Aug. 13	Aug. 23	Aug. 30
Nitrate of soda.....	33 lbs.....	8	6	5	7	4	4	6	4	3	3	3	3
Sulfate of ammonia..	33 lbs.....	7	5	5	6	3	3	5	3	2	2	2	2
Sulfate of ammonia + limestone.....	33 lbs. of each....	9	8	7	8	6	6	7	5	4	4	4	4
Hydrated lime.....	33 lbs.....	16	16	15	17	12	10	13	9	9	9	9	9
Sulfate of ammonia + Calo-clor.....	33 lbs..... 3 oz.....	4	2	2	4	2	1	3	1	1	0.5	0.5	0.5
Nu-green.....	1 lb.....												
Semesan.....	1 lb.....	4	2	1	2	1	0.5	2	0	0	0	0	0
Calo-clor.....	3 oz.....	4	2	1	2	1	0.5	2	0	0	0	0	0
Checks.....		26	28	30	38	40	40	50	50	50	50	50	50

† The percentage of infection was estimated by determining the percentage of square feet infected in each plot.
 * = Infection by *C. fuciforme*, May 24, June 20, and July 15.

Fertilizer applied on April 10.

Fungicides applied May 20, June 5, June 20, July 5, and July 15.

These experiments show that on fairways pink patch can be controlled by using either fertilizers or fungicides or a combination of both. Fertilizers appear to be the most practical means of control because most golf courses cannot afford to buy fungicides to treat their fairways.

An additional experiment was conducted on fairway turf in 1936 to determine the effects of several fungicides, Nu-green, Calo-clor, Semesan, and Fungol. The plots were five feet square and contained 25 square feet of turf. Three plots were used as checks. Single plots received Calo-clor at the rate of 3 ounces per 1000 square feet; Fungol, 4 ounces; Nu-green, 1 pound; and Semesan, 1 pound. These were each mixed with 20 pounds of screened sand and applied broadcast.

The turf was watered after each application. The first application was made June 2 and repeated every 10 days until September 1. Infection occurred June 2, July 6, and August 10.

The plots showed the following percentages of infection before the first application of the fungicides: Nu-green, 30; Semesan, 28; Calo-clor, 28; Fungol, 28; and the checks, 30. On July 2 the percentage of infection on the Nu-green plot was 3; Semesan, 1; Calo-clor, 1; Fungol, 4; and the check plots, 35. On July 6 new infection developed and the Nu-green plot showed 10; Semesan, 7; Calo-clor, 6; Fungol, 12; and the checks, 45 per cent. Infection then decreased until on August 10, when new infection developed and all plots showed an increase of the pathogen. The check plots showed an infection of 60 per cent. The infection then decreased and on August 30, Nu-green plots showed five-tenths of one per cent infection; Semesan, no infection; Calo-clor, no infection; Fungol, five-tenths of one per cent; and the checks, 60 per cent. This experiment shows that the pathogen can be controlled by the use of these fungicides after infection has occurred (Table 7).

TABLE 7. Control treatments for *Corticium fuciforme* on jarrovs, 1935

Fungicide	Amount per 1000 sq. ft.	Estimated percentage of infection per plot†											
		June 2*	June 12	June 22	July 2	July 6*	July 16	July 26	Aug. 10*	Aug. 20	Aug. 30	Aug. 30	Aug. 30
Nu-green.....	1 lb.....	30	10	5	3	10	5	3	2	8	3	3	0.5
Semesan.....	1 lb.....	28	6	3	1	7	3	1	0.5	4	1	1	0.0
Caboclor.....	3 oz.....	28	4	2	1	6	2	0.5	T	3	T	T	0.0
Fungol.....	4 oz.....	28	8	5	4	12	7	5	3	7	3	3	0.5
Check.....		30	33	35	38	45	48	50	50	60	60	60	60.0

† The percentage of infection was estimated by determining the percentage of square feet infected in each plot.

* Infection by *C. fuciforme*, June 2, July 6, and August 10.

† Treatments applied on June 2, June 12, June 22, July 2, July 12, July 22, August 1, August 10, August 20, and August 30.

Treatment of Turf on Lawns

Pink patch is also found on lawns where it causes dead and unsightly areas. Experiments to study the control of the pathogen were conducted on five lawns. Lawn number one had never been fertilized and consisted of 95 per cent Hair fescue and 5 per cent weeds. The turf was watered after fertilizer was applied. The grass showed an infection of 90 per cent and the pathogen had damaged all the aerial portions of the grass. The lawn was a mass of dead and unsightly turf. Sulfate of ammonia was applied at the rate of 33 pounds per 1000 square feet. This was mixed with 10 quarts of screened compost and applied with a wheelbarrow seeder. The lawn contained 10,000 square feet. Half of the area was treated and the remainder used as a check. The immediate treated area was stimulated. The grass grew rapidly and the infection decreased. On July 10, the check still showed an infection of 90 per cent while on the treated area the infection was reduced to 40 per cent. On August 24 the check showed 90 per cent infection and was dead and a dirty-white in color. The treated area showed 10 per cent infection and the turf was dense and green. The check was not mowed after July 10. The treated area was mowed twice a week until October 1. This experiment shows that the pathogen can be controlled on neglected lawns by the use of a nitrogenous fertilizer.

A similar experiment was conducted on lawn number two containing hair fescue, 25 per cent; Rhode Island Colonial bent, 50 per cent; and Kentucky bluegrass, 25 per cent. The infection of pink patch amounted to 60 per cent. This lawn contained 10,000 square feet; 5,000 square feet was treated and the remainder was untreated. Sulfate of ammonia, 33 pounds plus Calo-clor at three ounces per 1000 square feet mixed with 10 quarts of screened compost was applied broadcast on June 2, 1935. The turf was watered immediately. The immediate effect was stimulation. The grass grew rapidly and the infection decreased. On August 24 the check plot showed 60 per cent and the treated area only 7 per cent infection. The turf was dense and green. This experiment showed that a combination of fertilizer and fungicide would control the pathogen.

Additional experiments were conducted on lawn number three which contained Rhode Island Colonial bent, 40 per cent; Kentucky bluegrass, 40 per cent; and hair fescue, 20 per cent. The plots were five feet square and contained 25 square feet of turf. Four single plots were treated and two were used as checks. The following amounts of fungicides, per 1000 square feet, were each mixed with 20 quarts of screened sand and applied broadcast; Calo-clor, three ounces; calomel, 3 ounces; Fungol, 4 ounces; and Semesan, 1 pound. These were applied June 2, July 15, and August 22. Turf was watered after each application.

Infection occurred June 2, July 15, and August 22. Infection on June 2 on the Calo-clor plot was 35; calomel plot, 33; Fungol plot, 38; Semesan plot, 35; and on the check plots, 35 per cent. The infection decreased on the treated plots and on July 10 it was recorded as 10 on the Calo-clor, 25 on the calomel, 12 on the Fungol, and 10 per cent on the Semesan plots. The check plots still showed an infection of 35 per cent.

New infection occurred on July 15 and the amount of damage recorded on that date on the Calo-clor plot was 16; calomel plot, 30; Fungol plot, 18; Semesan plot, 15; and on the check plots, 40 per cent. The infection

decreased on the treated plots and on August 20 the Calo-clor plot showed six; calomel plot, 13; Fungol plot, 8; and the Semesan plot showed 6 per cent. The infection on the check plots was 40 per cent. Another infection occurred on August 22 and the amount on each plot was as follows: Calo-clor, 10; calomel, 18; Fungol, 12; Semesan, 10; and on the check plots, 50 per cent. The amount of infection on September 10 was as follows: Calo-clor, five; calomel, 8; Fungol, 6; Semesan, 4; and the check plots, 50 per cent. This experiment showed that the fungicides controlled the pathogen. Calomel acted slowly but by September 10 showed good control.

The fourth experiment was conducted on the "Old Lawn" plots at the experiment station, Kingston, Rhode Island, in 1935. These plots had been in grass for 30 years. The plot used contained Kentucky bluegrass, 20 per cent; Rhode Island Colonial bent, 70 per cent; and hair fescue, 10 per cent. The plots were five feet square and contained 25 square feet of turf. Four single plots were treated and two were used as checks. The following amounts of fungicide, per 1000 square feet, were each mixed with 20 quarts of screened sand and applied broadcast: Calo-clor, three ounces; Fungol, four ounces; Nu-green, one pound; and Semesan, one pound.

The application was made June 1 and repeated at 10-day intervals until August 27. The turf was watered after each application. The pathogen was not present on the plots at the time of the first application but infection occurred on June 7. Percentage was as follows: Calo-clor plot, 1; Fungol, 3; Nu-green, 3; Semesan, 2; and the check plots, 35. Infection decreased on the treated plots. On June 27, the Calo-clor plot showed no infection; Fungol, five-tenths; Nu-green, 1; and the Semesan plot, no infection. The checks showed 42 per cent.

New infection occurred on July 5. At this time the Calo-clor plot showed one; Fungol, 2; Nu-green, 6; Semesan, 1; and the check plots, 50 per cent. On August 3 the Calo-clor plot showed no infection; Fungol, a trace; Nu-green, two; Semesan, 1; and the check plots, 50 per cent. Another infection occurred on August 10 when the following infections were recorded: On the Calo-clor plot, five-tenths; Fungol, 2.5; Nu-green, 5; Semesan, 1; and on the check plots, 60 per cent. The last records were taken on August 30 and showed the following amounts of infection: on the Calo-clor plot, none; Fungol, none; Nu-green, 2; Semesan, none; and on the check plots, 65 per cent.

This experiment shows that pink patch could be controlled by applying the fungicide before infection took place. Each of the four fungicides gave good control (Table 8).

TABLE 8. *Control treatments for Corticium fuciforme on a well-established lawn, 1935*

Fungicide	Amount per 1000 sq. ft.	Estimated percentage of infection per plot†											
		June 1	June 7*	June 17	June 27	July 5*	July 15	July 25	Aug. 3	Aug. 10*	Aug. 20	Aug. 30	
Nugreen.....	1 lb.....	0	5	4	3	6	3	2	2	5	3	2	
Senesal.....	1 lb.....	0	2	1	0	1	0.5	0	0	1	0	0	
Fungol.....	4 oz.....	0	3	1.5	0.5	2	1	0.5	T	2.5	0.5	0	
Calo-clor.....	3 oz.....	0	1	0.5	0	1	0	0	0	0.5	0	0	
Checks.....		0	35	38	42	50	50	50	50	60	65	65	

† = The percentage of infection was estimated by determining the percentage of square feet infected in each plot.

* = Infection by *C. fuciforme* June 7, July 5, August 10.

Treatments applied on June 1, June 10, June 20, June 30, July 9, July 19, July 20, August 7, August 17, and August 27.

The fifth experiment was conducted on lawn number five seeded to Rhode Island Colonial bent in 1931 and had received applications of fertilizer. The plots were 10 feet square and contained 100 square feet of turf. Single plots were treated with fungicides and one plot was used as a check. The following amounts of fungicides, per 1000 square feet, were each mixed with 20 quarts of screened sand and applied broadcast: Calo-clor, 3 ounces; calomel, 3 ounces; Fungol, 4 ounces; and Semesan, 1 pound. These fungicides were applied on June 4, July 15, and August 22. The turf was watered after each application.

Infection occurred on June 2, July 15, and August 22. The infection on the Calo-clor plot was 30; calomel, 26; Fungol, 28; Semesan, 28; and on the check plot, 30 per cent. Infection decreased on the treated plots and on July 7 it was recorded as none on the Calo-clor plot; calomel, 8; Fungol, 4; Semesan plot, 2; and the check plot showed 30 per cent infection.

New infection occurred on July 13 and the amount of damage was recorded on that date as follows: on the Calo-clor plot, 5; calomel, 10; Fungol, 7; Semesan, 6; and on the check plot as 40 per cent. Infection decreased on the treated plots and on August 14, the Calo-clor plot showed none; calomel, 2; Fungol, 1; and the Semesan plot, none. The infection on the check plot was 40 per cent. Another infection occurred on August 22 and the amount on each plot was as follows: Calo-clor, 6; calomel, 8; Fungol, 8; Semesan, 8; and check plot 45 per cent. The last reading was taken on September 10 and the amount of infection on the Calo-clor plot was none; calomel, 2; Fungol, 1; Semesan, five-tenths; and on the check plot it was 45 per cent.

The experiment shows that pink patch could be controlled on highly fertilized lawns by the use of a fungicide. This control was accomplished after infection of the turf (Table 9).

For improvement of poor turf on lawns and fairways, nitrogenous fertilizers are essential, but on golf greens and lawns already highly fertilized they will not serve the same purpose and as a consequence fungicides are necessary.

TABLE 9. Control treatments for *Corticium fasciforme* on a highly fertilizer lawn, 1935

Fungicide	Amount per 1000 sq. ft.	Estimated percentage of infection per plot†										Sept. 1	Sept. 10
		June 2*	June 7	June 17	June 27	July 7	July 15*	July 25	Aug. 4	Aug. 14	Aug. 22*		
Semesan.....	1 lb.....	28	20	15	3	2	6	3	2	0	8	3	0.5
Calo-clor.....	3 oz.....	30	21	12	1	0	5	2	1	0	6	1	0.0
Calomel.....	3 oz.....	26	25	20	14	8	10	6	3	2	8	4	2.0
Fungol.....	4 oz.....	28	20	16	10	4	7	4	3	1	8	2	1.0
Check.....	Nine.....	30	30	30	30	30	40	40	40	40	45	45	45

† The percentage of infection was estimated by determining the percentage of square feet infected in each plot.

* = Infection by *C. fasciforme* June 2, July 15, and August 22.

Treatments applied on June 4, July 15, and August 22.

SUMMARY

The signs and symptoms of *Corticium fuciforme* are confined to the aerial portion of turf grasses. The pathogen forms an effuse gelatinous layer attached to the leaves and stems of the grass plant. From this layer fine hyphae emerge, forming a pinkish web between the leaves. Sclerotia and additional gelatinous layers are formed as the pathogen extends out from each infection center, binding the leaves and stems of the grass together. Symptoms of necrosis first appear at the point of infection which may occur any place on the leaf or leaf sheath. In the early stages, the infected tissues are water soaked; later they become dry and lose their color. The turf is injured and discolored in areas two to six inches in diameter. In the greenhouse the characteristic symptoms of the pathogen develop in two days after planting of mycelium or sclerotia.

Pink patch (*C. fuciforme*) has been known in Australia since 1854. The first report of the pathogen in the United States was from Rhode Island in 1932. Since then the pathogen has been found throughout New England and reports indicate that the pathogen exists in New York, New Jersey, South Carolina, and Oregon. Pink patch infects the turf on golf greens, fairways and lawns, where it causes imperfect and unsightly areas.

The color of the mycelial growth on artificial media varied from a whitish pink on potato dextrose agar to an intense pink on Williams' agar. The most abundant growth occurred on beer wort agar (pH 4.9) and potato dextrose agar (pH 5.6) when incubated at 20° C. The minimum for growth of *C. fuciforme* is near a pH of 3.6, the optimum between a pH of 4.4 and 6.2 and the maximum near a pH of 8.0.

Temperature relationships were as follows: the minimum about 1° C., the optimum at 20° C., and the maximum between 25° C. and 30° C. A temperature of 30° C. inhibits the pathogen.

From studies in the greenhouse, the following new hosts were reported: Redtop, Kentucky bluegrass, velvet bent and colonial bent. From field studies additional hosts were recorded. They were red fescue, hair fescue, and annual bluegrass.

Studies conducted with certain fungicides showed that at the highest dilution some inhibition was evident although some growth, in many instances very slight, occurred on media with 1-1000 parts of the fungicide.

Laboratory studies with mercury vapor showed that it would definitely kill the sclerotia of pink patch in 72 hours.

In various field studies conducted on putting greens, fairways and lawns a satisfactory control of the pathogen was secured by application of a number of fungicides. These were as follows: Semesan at the rate of one pound per 1000 square feet; Calo-clor, 3 ounces per 1000 square feet; and Fungol, 4 ounces per 1000 square feet. Satisfactory control was secured regardless of whether the materials were applied before or after infection had occurred. It was also demonstrated that the use of nitrogenous fertilizers such as sulfate of ammonia or nitrate of soda at the rate of 35 pounds per 1000 square feet on poor lawns or poor fairways would check the pathogen.

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